Overview: Networking and Information Technology R&D (NITRD) Program's High Confidence Software and Systems (HCSS) Coordinating Group (CG)

Remarks Given at the Joint Workshop on High Confidence Medical Devices, Software, and Systems (HCMDSS) and Medical Device Plug-and-Play Interoperability (MD PnP)

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Outline

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NITRD Authorization

- **High-Performance Computing Act of 1991 (Public Law 102-194)**
  - Directs the President to implement what is now the NITRD Program that establishes goals and priorities and provides for interagency coordination
  - Directs the Director of the Office of Science and Technology Policy (OSTP) to submit to Congress an annual Supplement to the President's Budget for the NITRD Program
  - Directs the President to establish the President's Information Technology Advisory Committee (PITAC) [currently assigned to the President's Council of Advisors on Science and Technology (PCAST)]

NITRD Program Coordination

White House
Executive Office of the President

Office of Science and Technology Policy

President's Council of Advisors on Science and Technology (PCAST) serving as the **President's Information Technology Advisory Committee (PITAC)**

National Science and Technology Council

Committee on Technology

National Coordination Office (NCO) for Networking and Information Technology Research and Development

Subcommittee on Networking and Information Technology Research and Development (NITRD)

High End Computing (HEC) Interagency Working Group

Cyber Security and Information Assurance (CSIA) Interagency Working Group

Large Scale Networking (LSN) Coordinating Group

High Confidence Software and Systems (HCSS) Coordinating Group

Human Computer Interaction and Information Management (HCI&IM) Coordinating Group

Social, Economic, and Workforce Implications of IT and IT Workforce Development (SEW) Coordinating Group

Software Design and Productivity (SDP) Coordinating Group

NITRD

Agency NITRD Budgets by PCA

FY 2008 Budget Requests (dollars in millions)

Agency	HEC I&A	HEC R&D	CSIA	HCI&IM	LSN	HCSS	SEW	SDP	Totals
NSF	303.1	67.1	69.2	225.6	106.7	57.4	109.3	55.3	993.7
OSD and DoD Service research orgs.	234.1	2.0	23.3	78.7	137.8	31.5		4.3	511.8
NIH	131.7	1.8	1.2	194.5	65.4	8.2	11.9	2.9	417.6
DARPA		68.9	96.9	204.3	42.4				412.5
DOE/SC	250.5	67.0			47.3		5.0		369.8
NSA		60.3	15.8		1.4	25.2			102.6
NASA	69.2		0.3	8.0	3.1	2.0		2.0	84.6
NIST	2.4	1.3	11.1	7.8	5.3	17.5		5.0	50.4
AHRQ				39.8	5.0				44.8
DOE/NNSA	9.8	17.8			1.5		4.7		33.8
NOAA	16.4	1.9		0.5	2.9			1.6	23.3
EPA	3.3			3.0					6.3
NARA				4.5					4.5
Totals	**1,020.5**	**288.0**	**217.7**	**766.7**	**418.8**	**141.9**	**130.9**	**71.2**	**3,056**

Economic Context: Calibrating U.S. Competitiveness

- **American Competitiveness Initiative announced:** http://www.whitehouse.gov/stateoftheunion/2006/aci/
  - Calls for a doubling over 10 years of the investment in three Federal agencies — NSF, DOE/SC, and NIST — that support basic research programs in the physical sciences and engineering
  - All three are NITRD Program member agencies; received 2007 budget request increases that exceed the percentage increase in the overall NITRD budget
    - NSF: 12% increase
    - DOE/SC: 35% increase
    - NIST: 10% increase
    - Collective increase for ACI agencies is $186 million (17% above 2006 estimates)
  - Increase in ACI agency budgets accounts for over 85% of the overall NITRD Program budget increase for 2007
  - These agencies' physical sciences and engineering R&D will play a key role in generating technical advances in IT systems

NITRD Program Goals

- Provide R&D foundations for assuring continued U.S. technological leadership in advanced networking, computing systems, software, and associated information technologies
- Provide R&D foundations for meeting the needs of the Federal government for advanced networking, computing systems, software, and associated information technologies
- Accelerate the development and deployment of these technologies in order to maintain world leadership in science and engineering; enhance national defense and national and homeland security; improve U.S. productivity and competitiveness and promote long-term economic growth; improve the health of the U.S. citizenry; protect the environment; improve education, training, and life-long learning; and improve the quality of life

NCO Support for NITRD Coordination

- **Technical support for workshops, meetings, studies, industrial interactions**
- **Technical and administrative support for the PCAST/NIT Subcommittee**
  - Includes support for the NIT Technical Advisory Committee (TAG)
  - At the April 24, 2007 PCAST meeting, PCAST/NIT Subcommittee Co-Chair Dan Reed stated that systems connecting IT and the physical world are a national R&D priority
- **Production of major Federal reports**
  - Research Needs Reports
  - Reports derived from HCSS national workshops
  - Special reports (e.g., NITRD Grand Challenges)
  - Federal Plans
  - PITAC reports and forthcoming PCAST assessment of the NITRD Program

High-Confidence Software and Systems (HCSS) Agencies

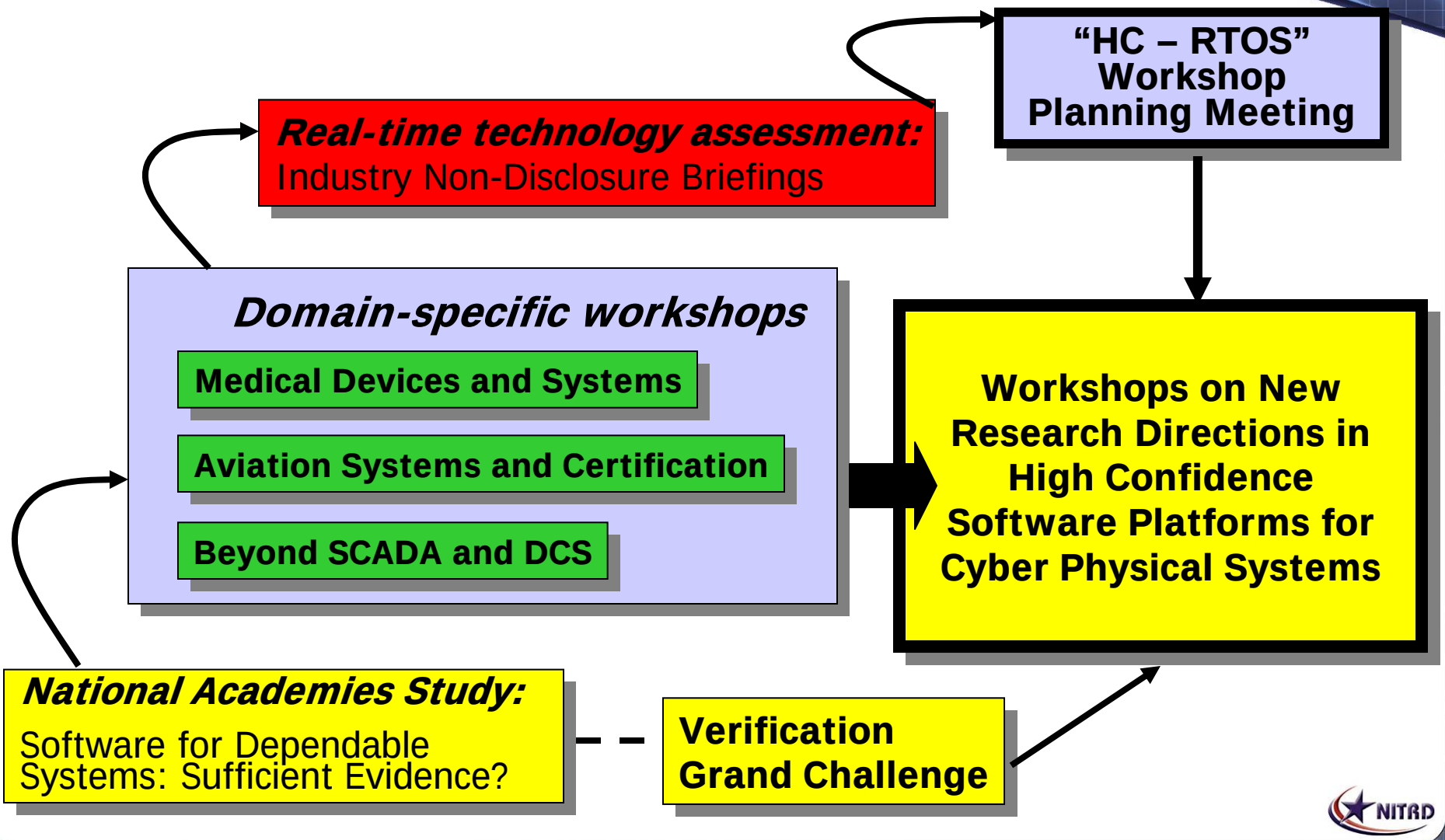
- Air Force Research Laboratories and Air Force Office of Scientific Research*
- Army Research Office*
- Department of Defense / Office of the Secretary of Defense
- Defense Advanced Research Projects Agency
- Department of Energy / OE
- Department of Homeland Security*
- Federal Aviation Administration*
- Food and Drug Administration*
- National Aeronautics & Space Administration
- National Institutes of Health
- National Institute of Science and Technology
- National Science Foundation
- National Security Agency
- Office of Naval Research*

* Participating Agencies

HCSS R&D Goals

- Bolster the nation's capability and capacity for engineering effective and efficient distributed, real-time, IT-centric systems that are certifiable and inherently dependable, viable, safe, secure, fault-tolerant, survivable, and trustworthy
- These systems, which are often embedded in larger physical and IT systems, are essential for the operations and evolution of the country's national defense, key industrial sectors, and critical infrastructures

HCSS CG Activities:
HCSS R&D Needs Assessment



HCSS CG Activities (1/6)

- **National workshops to identify R&D -- and education -- needs**
  - High confidence medical devices, software, and systems
    - Planning Workshop, Arlington VA, November 2004, http://www.cis.upenn.edu/hasten/hcmdss-planning/
    - National R&D Road-Mapping Workshop, Philadelphia, Pennsylvania, June 2005, http://www.cis.upenn.edu/hcmdss/
    - Joint Workshop on High Confidence Medical Devices, Software, and Systems (HCMDSS) and Medical Devices Plug and Plan (MD PnP) Interoperability, June 25-27, 2007, http://www.cis.upenn.edu/hcmdss/
  - Aviation safety and certification (HCSS-AS)(NSF, AFRL, NASA, FAA)
    - Planning Workshop, Seattle, WA, November 9-10, 2005, http://chess.eecs.berkeley.edu/hcssas/previousMeetings.html
    - National R&D Road-Mapping Workshop, Alexandria, Virginia, October 5-6, 2006, http://chess.eecs.berkeley.edu/hcssas/index.html
  - "Beyond SCADA" – advanced NIT for control of complex physical systems (e.g., power grid, manufacturing control, environmental monitoring and control) (National Workshop, 2006, CMU) (NSF, NIST, NSA)
    - U.S. Planning Workshop, Washington, DC, March 14-15, 2006, http://www.truststc.org/scada/march06_plan.html
    - US National R&D Road-Mapping Workshop, Pittsburgh, Pennsylvania, November 8-9, 2006, http://www.truststc.org/scada/

HCSS CG Activities (2/6)

- **National workshops to identify R&D – and education – needs (continued)**
  - Emerging, cross-cutting system software requirements for complex, real-time, networked, embedded NIT for future physical and engineered systems ("cyber-physical systems")
    - *National Planning Meeting for the National Workshop on New Research Directions in High Confidence Software Infrastructure for Distributed Real-Time and Embedded (DRE) Systems Technologies*, July 10, 2006, Arlington, Virginia, http://www.isis.vanderbilt.edu/HCRTOS/
    - *National Workshop on High Confidence Software Platforms – Cyber Physical Systems* , November 30, December 1, 2006, Alexandria, Virginia, http://www.isis.vanderbilt.edu/hcsp-cps
    - *National Workshop on Composable and Systems Technology for High Confidence Cyber Physical Systems* (Second follow-on workshop scheduled for July 9-10, 2007, Arlington, Virginia, www.isis.vanderbilt.edu/CST.HCCPS

HCSS CG Activities (3/6)

- **National workshops to identify R&D – and education – needs (continued)**
  - STEM education to advance HCSS objectives (*National Workshop on Stimulating Excitement and Discovery in K-12 STEM Education*, August 1-2, 2007, at North Carolina State University, Raleigh, North Carolina) (What can stakeholders do to stimulate excitement and discovery in STEM K-12 education?) http://www.wolftech.ncsu.edu/conference/index.php?
- **HCSS Writers' Workshop, June 8-9, 2007 in Philadelphia**
  - (Draft) Guidelines for NITRD R&D Needs Workshops and Workshop Reports
- **Annual NSA HCSS Conferences (since 2000)**
  - *www.ccmit.org*

HCSS CG Activities (4/6)

- **Production of reports on HCCPS R&D needs and roadmapping activities**
- **National Academies Study funded by the HCSS CG**
  - *Software for Dependable Systems: Sufficient Evidence?* (Copies of the pre-publication version are available at the registration table), http://www7.nationalacademies.org/cstb/project_dependable.html
  - Final study (targeted for completion in July 2007)
  - Public meeting to release the study (targeted for this summer at the National Academies, Washington, D.C.)
- **Working at the technical level with the Office of the National Coordinator for Health Information Technology to develop the case for a national focus on the importance of "medical device safety" as a subset of "patient safety."**
- **Working with the NSTC's Aeronautics and Space S&T Subcommittee in its efforts to develop a Federal Aeronautics R&D Plan and an associated Infrastructure Development Plan**

HCSS CG Activities (5/6)

- **Industry (including systems integrators and developers) one-time-only non-disclosure briefings (Fall 2005 – Winter 2006)**
  - Systems Integrators: Adventium Laboratory, Boeing, Ford Motor Company, Lockheed Martin, MIT Lincoln Laboratory, Northrop Grumman, Raytheon, Rockwell Collins, MotoTron
  - Technology Developers: Sun Microsystems, IBM, Microsoft, Honeywell, Red Hat, Wind River Systems, Green Hills, LinuxWorks, Real-Time Innovations, Inc., QNX Software Systems, Ltd., BAE Systems, Kestrel Technology, BBN Technologies

HCSS CG Activities (5.1/6)

- **Technical gaps confirmed in vendor briefings**
  - Lack coherent framework with interoperable, scalable real-time technology services:
  - Coordination services (e.g., timed/synchronized, reactive)
  - Dynamic hard/soft real-time scheduling
  - System security services
  - Recovery services
  - Secure, real-time networking capability for critical infrastructures
  - Principled system and software architectures and platforms for high-confidence sensing and control systems
  - Rational virtualization and architectural strategies to replace chaotic system stack (RTOS, virtual machines, middleware)
  - Flexible partitioning for mixed-criticality, mixed-security-level systems
  - End-to-end design and composition technology for high-confidence systems, configuration management
  - Support for certification of systems software technology, applications, design and development tools

HCSS CG Activities (6/6)

- **Open Verification Initiative**
  - Response to Hoare Verification Grand Challenge: Open verification technology for industrial-strength system and software analysis and composition
  - Open Verification Workshop, SRI "Little Engines of Proof" Kickoff, Arlington, VA, April 12, 2004
  - NSA HCSS Meeting, Hoare Grand Challenge Panel, April 13-15, 2004
  - SRI Workshop,Menlo Park February 21-23, 2005, http://www.csl.sri.com/~shankar/VGC05
  - IFIP Working Conference, Zurich, October 10-13, 2005, http://vstte.inf.ethz.ch/
  - SRI "Mini-Workshops" – Palo Alto, CA, April 1-3, 2006
  - Roadmap, executive group – kickoff September, 2006

Goals for HCMDSS/MD PnP 2007 Workshop

- **Cooperative HCMDSS effort between NITRD HCSS and HCI&IM CGs**
- **Expand HCMDSS R&D needs to further critical topics**
  - Extend the scope and content of the NITRD HCMDSS report, currently in preparation

For more information, questions, or comments

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